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(56) Documents Cited

**WO 95/35043 A1 WO 95/24520 A1 WO 95/14398 A1**

(58) Field of Search

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(54) Abstract Title

**Cigarette filter paper comprising synthetic polymer and lyocell fibres**

(57) A paper suitable for use in cigarette filters comprises synthetic polymer fibres bonded to each other at the cross-over points of the synthetic fibres and fibrous lyocell. The bonding may be by means of an adhesive, but preferably by heat fusion. The lyocell is preferably fibrillated, and may be in the form of fibres and/or floc. The paper has a neutral taste, and achieves low tar deliveries with less need for ventilation.

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PAPER

The present invention relates to paper intended particularly, but by no means exclusively, for use as a filter for cigarettes or other rod-shaped smokers articles (hereinafter referred to generally as cigarettes for convenience).

Filters for cigarettes generally comprise a fibrous medium and are intended to reduce the amount of tar and nicotine in the smoke produced by the burning tobacco before the smoke is inhaled by the smoker. In fact, filters may be designed so as to deliver specific amounts of tar and nicotine to the smoker.

One known type of filter is comprised of a tow of cellulose acetate filaments which are arranged generally parallel to the longitudinal axis of the filter. A further type of cigarette filter comprises paper which is of natural cellulosic fibres (e.g. wood pulp) and which has been compressed (possibly after pre-grooving) into the cylindrical form of the filter. These single component filters are known as "Mono Filters" whilst constructions containing two or three filter elements are known as "Dual Filters" or "Triple Filters" and may contain elements such as paper and fibre tow segments as well as void areas which may contain chemicals such as activated charcoal or simply an air gap.

There is now a trend towards the use of filters which provide for delivery of low amounts of tar (1 to 6 mg) and nicotine in the smoke inhaled by the smoker. It is known that conventional paper filters are more efficient at removing tar than are cellulose acetate filters and as such conventional paper filters have desirable filtration properties for use in so-called low tar cigarettes. Conventional paper filters do however suffer the disadvantage that they are considered to impart a "papery" taste to the smoke to be inhaled. Filters made from cellulose acetate fibres provide a more neutral taste but are less efficient at tar removal.

A development in the field of cigarette filters is disclosed in WO-A-9514398 (Courtaulds Plc.) which proposes filters comprised, or consisting, of lyocell fibres.

Lyocell fibres are of particular benefit for use as cigarette filters since they act as a very efficient mechanical filter for removing tar and nicotine. However paper comprised of 100% lyocell fibres suffer a number of disadvantages. In particular, difficulties are encountered in producing 100% lyocell papers of uniform characteristics across the width, and along the length, of the web thus producing a filters of non-uniform efficiency. The paper can be relatively weak and consequently the production and reeling of the paper as well as the manufacture of filter rods therefrom can be problematic.

In order to remedy these disadvantages it has been proposed to produce filters from a paper comprised of 50% lyocell fibres and 50% wood pulp.

In addition to having the desired filtration characteristics, this product has improved product uniformity and physical strength properties facilitating efficient manufacture of the paper and production of filter rods therefrom. Such paper has the advantage of lower cost than 100% lyocell paper but the disadvantage that, in certain markets, filters produced therefrom are considered to have an undesirable "taste signature".

In conducting development work to solve the abovementioned disadvantages we have established that a paper comprised of 50% of lyocell fibres and 50% of "unbonded" synthetic polymer fibres had an improved taste profile as well as desired filtration characteristics. However the product had unsatisfactory physical strength as well as poor product uniformity and was therefore not entirely suitable for manufacture of filter rods on a commercial scale.

We further established that a product comprised of 50% lyocell fibres, 42% "unbonded" synthetic polymer fibres and 8% floc binder gave improved physical strength properties (as compared to the paper described in the previous paragraph) but these properties were still insufficient for successful commercial manufacture of paper and filter rods.

This development work has lead to the present invention which seeks to obviate or mitigate the aforementioned disadvantages. According to a first aspect of the present invention there is provided a paper for use particularly, but not exclusively, in producing a filter for a cigarette, the paper comprising synthetic polymer fibres bonded to each other at cross-over points of said synthetic fibres and fibrous lyocell.

The production of lyocell is described in US-A-4 246 221 and involves dissolution of cellulose in a solvent (typically a tertiary amine N-oxide such as N-methylmorpholine, N-oxide in admixture with water) and spinning the resultant dope. Lyocell is available under the Trade Mark TENCEL.

The paper of the invention has a combination of properties which make it particularly suitable for commercial production and conversion into filters for cigarettes. In particular, the synthetic polymer fibres which are bonded to each other at their cross-over points provide for strength and uniformity of the product which render it suitable for the aforementioned commercial manufacture and conversion. These bonded synthetic fibres provide a matrix for supporting the fibrous lyocell fibres which provide the paper with excellent filtration characteristics. Overall the paper has a neutral taste signature and, as indicated, is therefore particularly suitable for use as a filter for a cigarette. The paper is however also suitable for other applications where these properties are of benefit, e.g. in the case where the synthetic polymer fibres are capable of being fused together the paper may be used as a heat-seal paper for the production of teabags or other beverage infusion sachets. For this

purpose, the paper may be provided with a cellulose insulation layer as conventional for heat-seal papers (for preventing the synthetic fibres sticking to the heated dies used in manufacture of beverage infusion sachets). Further uses for the paper of the invention are in air filtration applications, e.g. face masks and respirator filters, air conditioning filters, and automotive filters. A further use is as lens cleaning tissue (since the paper does not shed fibres and may be produced in a soft conformable form) and for wet wipes and other applications.

It is a feature of the paper of the invention that it comprises synthetic fibres which are bonded together at their cross-over points. This bonding may be by means of an adhesive agent but is more preferably effected by heating such that the synthetic polymer fibres are fused to each other at their cross-over points. The bonded synthetic fibres provide, in effect, a matrix on which the fibrous lyocell (providing the filtration characteristics of the paper) is supported. This matrix may also be used to support any other materials for providing desired characteristics for the paper, e.g. in the case of paper for cigarette filters cellulose acetate may be incorporated in the matrix.

The paper may be produced by a conventional paper making process from a stock comprised of fibrous lyocell and synthetic polymer fibres. The web is formed on a papermaking wire (e.g. a so-called inclined wire machine) and in the case of fusion bonding of the synthetic fibres, then passed through heated drying apparatus where the web is subjected to temperatures sufficient to cause the synthetic polymeric fibres to fuse together at their cross-over points so as to provide improved structural integrity for the web material.

Typically the paper will have a basis weight of 9 to 50 g m<sup>-2</sup>, more preferably 20 to 30 g m<sup>-2</sup>, e.g. about 26 gm<sup>-2</sup>.

The fibrous lyocell in the paper is preferably fibrillated and may be in the form of lyocell fibres and/or lyocell floc. Thus, one embodiment of paper in accordance

with the invention may comprise 40-60% (e.g. ca 50%) by weight of bonded synthetic fibres and 40-60% (e.g. ca 50%) by weight of lyocell fibres. A further embodiment of paper may comprise 80-90% by weight of synthetic fibres and 2-50% by weight of lyocell floc.

Particularly preferred papers in accordance with the invention comprise the bonded synthetic fibres, lyocell fibres and a floc which may for example be lyocell floc but may alternatively or additionally be a vegetable floc or wood pulp floc. Preferably the paper comprises 10% to 75% lyocell fibres, 20% to 80% synthetic fibres and 2 to 50% floc, these percentages being by weight of the total weight of the paper.

Lyocell fibres for use in the invention will generally have a length of 1 mm to 15 mm, e.g. 3 to 6 mm, typically about 5 mm, and a cross-sectional size of 0.5 to 4.5 decitex, typically about 1.7 decitex. The lyocell fibres contribute to the filtration properties of the paper which render it particularly suitable for use as a cigarette filter.

Flocs for use in the invention are heavily fibrillated fibres and act as an effective binder to provide "classic" wet web strength. The floc will generally have a fibre length within the range 0.1mm to 1.5mm but preferably about 1.0mm. At this fibre length, the area coverage of the fibre is significantly increased, compared to a typical fibrillated 5mm fibre, by a combination of internal and external "cleaving" of the fibre wall surface. Generally the floc will have an SR value in the range 60° to 100°, more preferably 70° to 95°.

It is well known that flocs have a greater surface area than fibrillated fibres. In the case of a paper intended for manufacture of a cigarette filter, the use of lyocell floc gives the scope for use of higher levels of synthetic "taste neutral" fibres in the paper whilst still maintaining the filtration of tar and nicotine components to the desired

level. A paper to be used as a cigarette filter will preferably contain 2 to 50%, more preferably 10 to 20%, by weight of floc.

For certain applications such as air filtration, the use of increased levels of floc as opposed to the same amount of fibrillated fibre would give substantial increase in filtration properties. The paper of the invention for use in air filtration preferably contains 20% to 80%, more preferably 50% to 70%, by weight of floc.

As indicated, it is preferred that the synthetic polymer fibres are fused at their cross-over points. The fibres may for example be single component fibres having a melting point of at least 100°C, e.g. in the range 130°C to 180°C. These single component fibres may for example be of polypropylene, e.g. having a melting point of 165°C. It is however more preferred that the synthetic fibres are bicomponent fibres having a core and an outer sheath of lower melting point than the core such that during manufacture of the paper it is the sheath which melts to fuse the synthetic polymer fibres at their cross-over points whereas the core maintains its integrity to provide tenacity for the paper. Papers produced with the bicomponent fibres have improved dry tensile strength as compared to papers produced with single component synthetic fibres.

The bicomponent fibres may have a core (e.g. a polyester or polypropylene core) having a melting point of 165°C to 280°C (e.g. 260°C) and an outer sheath of a polymer (e.g. polyethylene or a copolyester) which melts at a temperature of 100 to 150°C. Preferred bicomponent fibres for use in the invention are available from Kuraray under the product numbers, N710, N720 and N720H and comprise a polyester core and a copolyester sheath which melts at 100-130°C.

Preferably the synthetic fibres have a length of 3 to 7 mm (e.g. about 5 mm) and a cross-section in the range of 1 to 3 decitex (e.g. about 2 decitex)

To produce the paper in accordance with the invention, it is preferred that the lyocell fibres are fibrillated. For preference, the lyocell fibres from which the papermaking furnish is produced have a degree of freeness of 15-60°SR, more preferably 20 to 40°SR, most preferably about 30°SR. Preferably also, the lyocell floc (from which the furnish is produced) has a degree of freeness of at least 60°SR (e.g. 60-100°SR), more preferably at least 70°SR, and most preferably 75-95°SR.

The paper may be produced using conventional papermaking techniques for laying long fibres (e.g. using an inclined wire papermaking machine). Fusion of the synthetic polymer fibres (for producing the preferred paper of the invention) may be effected by passing the web from the paper-forming step through a heated drying apparatus at a temperature sufficient to effect softening of the outer surface of the synthetic polymer fibres so that they become fused to each other at their cross-over points.

As indicated above, the paper of the invention is intended particularly (but not exclusively) for use as a filter for a cigarette. Therefore according to a second aspect of the invention there is provided a cigarette filter comprised of a paper in accordance with the first aspect of the invention.

According to a third aspect of the invention there is provided a cigarette incorporating a filter as defined for the second aspect of the invention.

Filters in accordance with the second aspect of the invention have a more acceptable "taste signature" than filters comprised of a 50% lyocell/50% wood pulp paper whilst providing a high tar removal efficiency over a wide range of pressure drops compared to cellulose acetate or paper (100% wood pulp) filters at an acceptable draw resistance. Moreover the filters of the invention are able to achieve tar deliveries of less than 6 mg with significantly lower levels of ventilation compared to prior art filters comprised of lyocell fibres and this is a particular advantage of the



invention since high levels of ventilation are generally regarded as undesirable by the consumer.

The paper of the first aspect of the invention may be converted to a cigarette filter rod (possibly after grooving) using an existing industrial standard filter rod making apparatus with the same, or improved, efficiencies as compared to known materials used for making filter rods; and the cut to length for use in providing a filter for a cigarette.

**CLAIMS**

1. A paper for use particularly, but not exclusively, in producing a filter for a cigarette, the paper comprising synthetic polymer fibres bonded to each other at cross-over points of said synthetic fibres and fibrous lyocell.
2. A paper as claimed in claim 1 wherein the fibrous lyocell is fibrillated.
3. A paper as claimed in claim 1 or 2 wherein the fibrous lyocell is in the form of lyocell fibres.
4. A paper as claimed in claim 3 wherein the lyocell fibres have a length of 1 mm to 15 mm.
5. A paper as claimed in claim 4 wherein the lyocell fibres have a length of 3 mm to 6 mm.
6. A paper as claimed in claim 5 wherein the lyocell fibres have a length of about 5 mm.
7. A paper as claimed in any one of claims 3 to 6 wherein the lyocell fibres have a cross-sectional size of 0.5 to 4.5 decitex.
8. A paper as claimed in claim 7 wherein the lyocell fibres have a cross-sectional size of about 1.7 decitex.
9. A paper as claimed in any one of claims 3 to 8 wherein the lyocell fibres from which the paper has been produced have a degree of freeness of 15 to 60°SR.

10. A paper as claimed in claim 9 wherein the lyocell fibres from which the paper has been produced have a degree of freeness of 20 to 40°SR.
11. A paper as claimed in claim 10 wherein the lyocell fibres from which the paper has been produced have a degree of freeness of about 30°SR.
12. A paper as claimed in any one of claims 1 to 11 incorporating a floc.
13. A paper as claimed in claim 12 wherein the floc comprises vegetable floc or wood pulp floc.
14. A paper as claimed in claim 12 or 13 wherein the floc comprises lyocell floc and provides at least part of the fibrous lyocell in the paper.
15. A paper as claimed in any one of claims 12 to 14 comprising 10% to 75% lyocell fibres, 20% to 80% synthetic fibres and 2% to 50% of floc, these percentages being by weight of the total weight of the paper.
16. A paper as claimed in any one of claims 1 to 15 wherein the floc has a fibre length of 0.1 mm to 1.5 mm.
17. A paper as claimed in claim 16 wherein the floc has a fibre length of about 1 mm.
18. A paper as claimed in any one of claims 12 to 17 wherein the floc from which the paper has been produced has a degree of freeness of at least 60°SR.
19. A paper as claimed in claim 18 wherein the floc from which the paper has been produced has a degree of freeness of at least 70°SR.

20. A paper as claimed in claim 19 wherein the floc from which the paper has been produced has a degree of freeness of 75-95°SR.
21. A paper as claimed in any one of claims 1 to 20 wherein the synthetic polymer fibres are bonded by fusion to each other at cross-over points of said synthetic fibres.
22. A paper as claimed in any one of claims 1 to 21 wherein the synthetic polymer fibres are single component fibres having a melting point of at least 100°C.
23. A paper as claimed in any one of claims 1 to 21 wherein the synthetic fibres are bicomponent fibres having a core and an outer sheath of lower melting point than the core.
24. A paper as claimed in claim 23 wherein the core of the bicomponent fibres has a melting point of 165°C to 280°C and the sheath of the fibres has a melting point of 100°C to 150°C.
25. A paper as claimed in claim 23 or 24 wherein the sheath of the bicomponent fibres comprises polyethylene, or a copolyester.
26. A paper as claimed in any one of claims 23 to 25 wherein the core of the bicomponent fibre comprises a polyester or polypropylene.
27. A paper as claimed in any one of claims 1 to 26 having a basis weight of 9 to 50 g m<sup>-2</sup>.
28. A paper as claimed in claim 27 having a basis weight of 20 to 30 g m<sup>-2</sup>.
29. A paper as claimed in claim 28 having a basis weight of about 26 g m<sup>-2</sup>.

30. A filter for a cigarette comprised of paper as claimed in any one of the preceding claims.

31. A cigarette comprising a filter as claimed in claim 30.



Application No: GB 9709768.7  
Claims searched: 1-31

Examiner: Paul Foot  
Date of search: 11 March 1998

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): D1R: RBF, RDD, RFH

Int Cl (Ed.6): A24D: 3/10

D21F: 11/14

D21H: 27/08

Other: Online: WPI

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
A	WO95/35043A1 (COURTAULDS FIBRES LIMITED)	
A	WO95/24520A1 (COURTAULDS FIBRES LIMITED)	
A	WO95/14398A1 (COURTAULDS FIBRES LIMITED)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.